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Short article

Section 1. Parathyroid
Minimally invasive radioguided parathyroidectomy

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Abstract

The recent development of radioguided parathyroidectomy has allowed parathyroidectomy to be quickly performed by a significantly less invasive procedure. Radioguided parathyroidectomy is also likely to decrease operation time, risk of complications, hospital stay, and the overall cost of patient care, result in a smaller scar and rapid, nearly pain-free recovery, and allow local anesthesia. Despite these apparent benefits, a case-control study showed no distinct advantages of employing intraoperative sestamibi identification during parathyroidectomy.

Keywords: Minimally invasive parathyroidectomy; Radioguided parathyroidectomy; Sestamibi

1. Introduction

The advent of 99mTc-methoxyisobutylisonitrile (sestamibi) scintigraphy in the early 1990s changed the management of primary hyperparathyroidism. Many recent reports have revealed preoperative sestamibi scintigraphy to have a sensitivity of approximately 90% and a specificity of almost 100% in identifying patients with a single adenoma [1]. A new procedure, known as radioguided parathyroidectomy, has been developed using this modality [2,3].

2. Review of radioguided parathyroidectomy for primary hyperparathyroidism

In 1995, Martinez et al. were the first to describe the advantage of radioguided parathyroidectomy. They reported three patients with positive preoperative sestamibi scintigrams who were dosed with sestamibi again before parathyroidectomy and found to have abnormal glands intraoperatively [4]. Gallowitsch et al. [5] reported being able to identify the abnormal glands with the gamma probe in 11 of 12 patients and that the method was feasible and might be especially useful for identifying ectopic adenoma.

Norman's group developed radioguided parathyroidectomy several years ago in an attempt to improve parathyroid surgery through application of the data afforded by clearly positive sestamibi scans in patients with sporadic primary hyperparathyroidism [2]. Murphy and Norman [2] found that lymph nodes, normal parathyroids, and fat never contained more than 2.2% of background radioactivity, whereas thyroid and hyperplastic parathyroids contained 5.5% and 7.5%, respectively, but never more than 16%. By contrast, adenomas were found to contain 59% of background activity, with a range of 18–136%, and any excised tissue containing more than 20% of background radioactivity was confirmed to be a solitary parathyroid adenoma. A study by McGreal et al. [6] supported the 20% rule. Their study showed that radioguided parathyroidectomy was successful in 97% of patients, and that adenomatous parathyroid glands contained more than 20% of the background activity. No correlations were found between PTH levels and the radioactivity counts of the removed adenoma, reflecting the heterogeneity of gland size and isotope uptake and of the serum hormone levels.

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The success of intraoperative detection of parathyroid tumors with sestamibi probes is governed by the difference in radioactivity levels between the parathyroid tumor and the adjacent tissues [3]. Thyroid nodules, thyroiditis, and hyperplastic lymphomatous lymph nodes can accumulate sestamibi and therefore result in false-positive foci [7]. One of the major limitations of sestamibi scintigraphy is related to the coexistence of thyroid nodules [8]. Casara et al. recommended that minimally invasive radioguided parathyroidectomy only be performed in patients with primary hyperparathyroidism who have scintigraphic and/or ultarasonographic evidence of a normal thyroid gland. Blocking the thyroid uptake of sestamibi, particularly by thyroid nodules, would considerably increase the detection rate with the sestamibi probe. Norman and Denham [9] reported placing six patients in whom the previous sestamibi scan demonstrated excessive activity in the thyroid gland on levothyroxine for 8 weeks before surgery and finding that the thyroid took up less radioactive pharmaceutical when thyroid-stimulating hormone levels were suppressed, thereby creating a larger differential in level of radioactivity between the thyroid gland and the parathyroid adenoma. Further studies are necessary to develop an agent that blocks thyroid uptake of sestamibi or a radiopharmacon that specifically accumulates in parathyroid tissue and not in other tissues [3].

Bonjer et al. [3] reported similar rates of success and complications in patients treated by probe-guided surgery and conventional surgery, and concluded that despite the sestamibi probe appearing to be a valuable tool in parathyroid surgery, its use does not improve the outcome of surgery. By contrast, Flynn et al. [10] found that minimally invasive radioguided parathyroidectomy resulted in correction of hypercalcemia in all patients, and concluded that it is a safe and effective procedure. The low postoperative complication rate, small incision, and rapid return to normal activities resulted in very high patient acceptance of the procedure.

Reoperative parathyroid surgery is associated with a complication rate that is several fold higher than that of first-time operations for the same disease. Norman and Denham [9] reported that all 24 primary hyperparathyroidism patients who had undergone at least one previous neck operation were cured after reoperation, and concluded that radioguided parathyroidectomy is extremely effective in patients who have undergone previous neck exploration for parathyroid or thyroid disease. They found that minimally invasive radioguided parathyroidectomy is likely to decrease the risk of nerve injury because of the limited dissection required and the directed nature of the technique [9]. They also reported that all 17 patients referred for persistent primary hyperparathyroidism after undergoing at least one neck operation were cured [11].

In a study on the cost-effectiveness of minimally invasive radioguided parathyroidectomy, Denham and Norman [12] found that radioguided parathyroidectomy is less expensive than the standard operation because of the shorter operating room and recovery room times, shorter hospital stay, and smaller number of frozen sections taken. Goldstein et al. [13] reported on 40 patients with primary hyperparathyroidism, 20 of whom were treated by minimally invasive radioguided parathyroidectomy and 20 of whom were chosen to match the minimally invasive radioguided parathyroidectomy patient population and treated by conventional standard parathyroidectomy. All 40 patients were cured of primary hyperparathyroidism, but the operation time, operative charges, and total hospital charges were significantly reduced in the minimally invasive radioguided parathyroidectomy group, resulting in significant cost reductions without compromising patient safety [13]. By contrast, Greene et al. [14] reviewed 41 bilateral neck explorations for primary hyperparathyroidism and compared their results with those obtained by meta-analysis to determine whether a sestamibi-directed approach is cost-effective. They concluded that the cost of a standard bilateral exploration at their institution was almost 50% less than the cost of the bilateral approach according to the published results of the meta-analysis, and the cure rate of their patients was 98%, with no cases of nerve injury or permanent hypercalcemia.

3. Initial experience with radioguided parathyroidectomy

We treated 21 patients with primary hyperparathyroidism by minimally invasive radioguided parathyroidectomy. There were nine men and 12 women (age range: 25–64 years). Twenty of the patients had been diagnosed with untreated primary hyperparathyroidism and one with persistent hyperparathyroidism. Ultrasonography was performed in all of the patients preoperatively.

Sestamibi scintigraphy was performed on the morning of surgery. Before surgery, the patients were intravenously injected with 20mCi of sestamibi. In all patients with a single adenoma, a 2-cm skin incision was made over the inferomedial border of the sternomastoid muscle. No subplatysmal lanes were created. The dissection down to the adenoma was guided from this point by a hand-held gamma probe. Once the targeted gland was removed, the radioactivity of the adenoma was measured ex vivo, and background radioactivity was simultaneously determined within the operative basin after each tissue excision. Radioactive ratios were calculated as a function of ex vivo tissue radioactivity and expressed as a simple percentage.

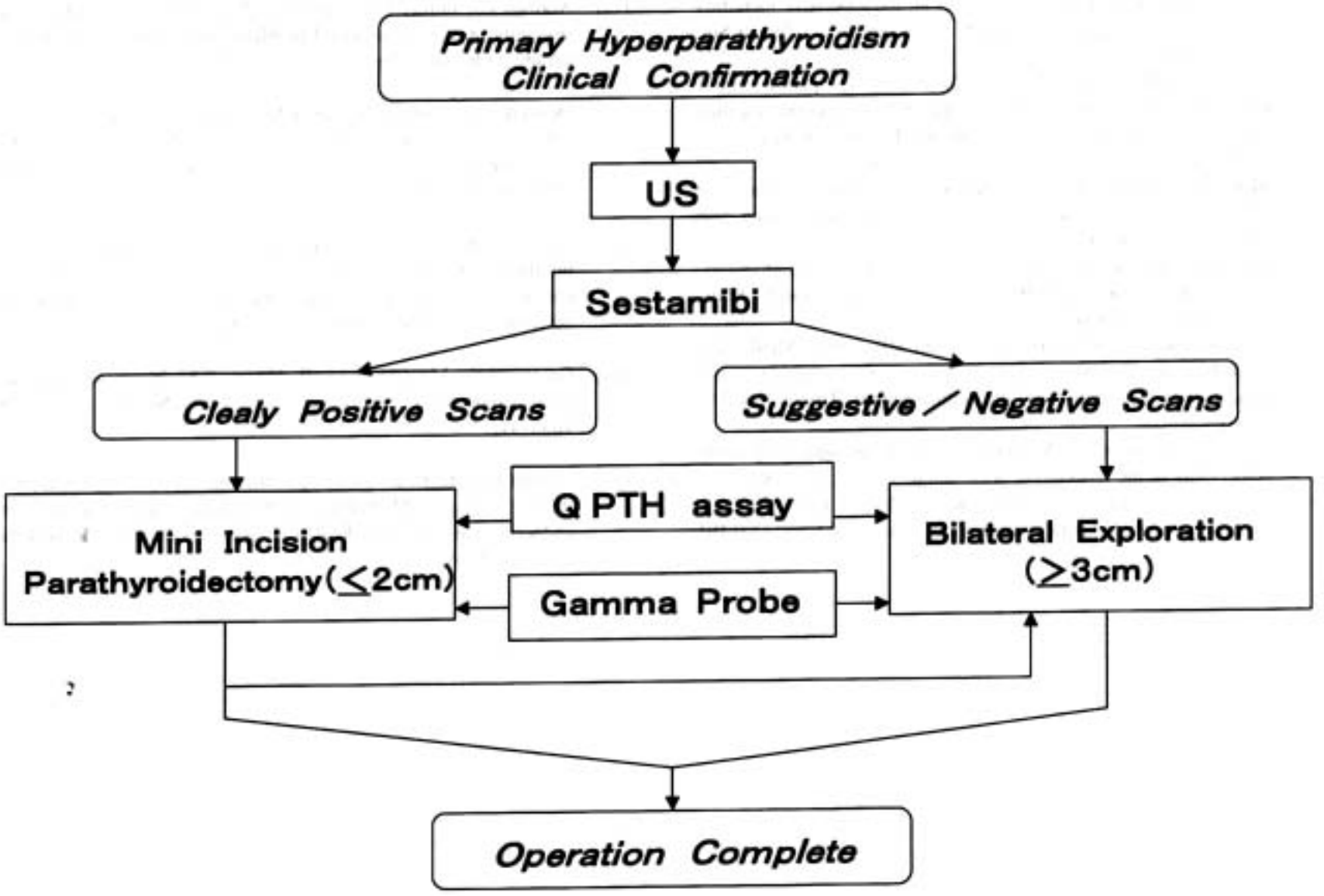

Fig. 1. Algorithm for minimally invasive radioguided parathyroidectomy.

A single adenoma was found in 18 of the patients (90%) operated on for untreated hyperparathyroidism, and a multigland mass was found in the other two patients. A single abnormal gland was found in one patient who was reoperated on for persistent hyperparathyroidism. Operation time was 65 min (45–131 min). A minor local complication, transient vocal cord dysfunction, occurred in one patient. There were no major local or systemic complications.

The single adenomas or abnormal glands were identified correctly by a sestamibi scintigram in 18 of 19 patients, and in 17 of the 19 patients by the gamma probe. In the two patients with multigland masses, three of the four masses were identified on sestamibi scintigrams, and two of them were identified with the gamma probe. The hypercalcemia was corrected in all 21 patients.

Fig. 1 shows the algorithm for minimally invasive radioguided parathyroidectomy. Surgery is scheduled after confirming the diagnosis of primary hyperparathyroidism, and sestamibi is injected 90–120 min before the operation. The procedure depends on the results of the scintigram: minimally invasive mini-incision parathyroidectomy is performed when the scan is clearly positive, whereas bilateral exploration is carried out when the scan is suggestive or negative.

Radioguidance was used much more selectively as experience accumulated, and radioguided parathyroidectomy is currently being used for sporadic primary hyperparathyroidism in patients with deep, retroesophageal lesions, ectopic glands, or persistent or recurrent hyperparathyroidism [15].

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